

St. Aloysius College (Autonomous), Jabalpur

Reaccredited 'A+' by NAAC (CGPA – 3.68/4.00)

College with Potential for Excellence by UGC

DST FIST Supported



Department of Mathematics

Syllabus

M.Sc. I to IV Semester

To be implemented in 2021-23

CHOICE BASED CREDIT SYSTEM (CBCS)

(For PG Programme in Mathematics from the academic year 2021-2023 onwards)

1. Eligibility

(i) Admission: Candidates who have passed the qualifying examination (UG) with Mathematics shall be given in admission to M.Sc. Mathematics Degree Programme.

(ii) Degree : The candidates shall have subsequently undergone the prescribed course of study in the college affiliated to the University for a period of not less than two academic years, passed the examinations prescribed and fulfilled such conditions as have been prescribed.

2. Duration

The course is for a period of two years. Each academic year shall comprise of two Semester, viz. Odd and Even Semester. Odd semesters shall be from July to November and Even Semesters shall be from January to April. There shall be not less than 90 working days which shall comprises of minimum 375 teaching clock hours for each semester. (Exclusive of the days for the conduct of Odd and Even Semester examinations).

3. Programme

M.Sc. Mathematics

4. The CBCS System

The Programme will run on Choice Based Credit System (CBCS). It is an instructional package developed to suit the needs of students to keep pace with the developments in higher education and the quality assurance expected of it in the light of globalization in higher education.

5. Paper Offered

Semester I

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	Paper	Title of the Paper
Core	I	Advanced Abstract Algebra- I
Core	II	Real Analysis-I
Core	III	Topology- I
Core	IV	Complex Analysis - I
Core	V	A. Functional Analysis - I
Elective		B. Integral Transform

Semester II

	Paper	Title of the Paper
Core	I	Advanced Abstract Algebra- II
Core	II	Real Analysis-II
Core	III	Ordinary and Partial Differential Equations
Core	IV	Complex Analysis - II
Core	V	A. Number Theory
Elective		B. Topology- II

Semester III

	Paper	Title of the Paper
Core	I	Operation Research - I
Core	II	Special Functions
Core	III	Numerical Methods - I
Core	IV	A. Programming in C
Elective		B. Functional Analysis - II
Open	V	A. Advanced Discrete Mathematics

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Elective	B. Mathematical Statistics
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Semester IV

	Paper	Title of the Paper
Core	I	Operation Research – II
Core	II	Numerical Methods - II
Core Elective	III	A. Divergent Series B. Programming in C++
Core Elective	IV	A. Integration Theory B. Fuzzy Sets and Their Applications
Open Elective	V	A. Mathematical Modeling
		B. Wavelets

CVV- Comprehensive Viva-Voce with maximum marks 100 and minimum marks 40.

6. Details of the Number of Papers / Credits per Paper / No. of Hours in the PG Programme

Theory					
Semester	No. of Papers	Credits per Paper	Total Credits	Total Hours per Week	Total Hours per Semester
I	4 Core	5		5 x 6 = 30	

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	1 E Core	5	25+ 1(Skill Development)= 26	Including Presentation for Viva-Voce	30 x 15 = 450
II	4 Core	5	25+ 1(Skill Development)= 26	5 x 6 = 30	30 x 15 = 450
	1 E Core	5			
III	4 Core	5	25+ 1(Skill Development)= 26	5 x 6 = 30	30 x 15 = 450
	1 Open Elec.	5			
IV	4 Core	5	25+ 1(Skill Development)= 26	5 x 6 = 30	30 x 15 = 450

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
FIRST SEMESTER
CORE PAPER I: ADVANCED ABSTRACT ALGEBRA-I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To make the students see and understand the connection and transition between previously studied mathematical concepts and more advanced mathematics.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1 Provide the knowledge of important mathematical concepts in abstract algebra such as groups, Abelian groups, subgroups, cyclic groups, and normal subgroups of a group.
- CLO2 Introduce many mathematical concepts such as Cauchy Abelian theorem, Sylow's theorems and various applications of Sylow's theorems.
- CLO3 Confer knowledge of series of groups: Normal and Subnormal series, Composition series and their properties.
- CLO4 Make the students participate actively in the vital concepts of abstract mathematics like Solvable groups, Nilpotent groups and their characteristics.
- CLO5 Appreciate the concepts of Extension field, Splitting field, Finite field, and related theorems.

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Unit-I: Another Counting Principle, Conjugacy Relation, Normalizer of an element of a Group, Class Equation and its theorems, Cauchy theorem for Finite Group (both Abelian and Non-Abelian), Sylow's first and second theorem, Double Coset, Application of Sylow's third theorem in Finite Groups.

Unit-II: Series of Groups: Normal and Subnormal Series, Composition Series, Zassenhaus lemma, Schreier Refinement theorem, Jordan Holder theorem.

Unit-III: Solvable Group and its properties, Commutator Subgroup and its theorem, Nilpotent Group and its properties.

Unit-IV: Fields: Extension Field and its theorem, Finite Extension, Algebraic element and its theorem, Algebraic and Transcendental Extension, Roots of Polynomials, Remainder theorem, Factor theorem, Splitting field and its theorems.

Unit-V: More about Roots: Derivative of a Polynomials and its theorems, Simple Extension and its theorems, Primitive element, Separable Extension, Perfect Field and its theorems, Finite Field and its theorems.

Text Books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975 (For Units I, III, IV, V).
2. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999 (For Unit-II).

Reference Books:

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Ed.), Cambridge University Press, Indian Edition, 1997.
2. I.S. Luther and I.B.S. Passi, Algebra, Vol. I, Groups, Narosa Publishing House, 1996.
3. Surjeet Singh and Quazi Zameeruddin, Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990.

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4. N. Jacobson, Basic Algebra, Vol. I & II, Hindustan Publishing Company, 1980.
5. S. Lang, Algebra, 3rd Edition, Addition-Wesley, 1993.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
FIRST SEMESTER
CORE PAPER II : REAL ANALYSIS - I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To make the students see and understand the connection and transition between previously studied Real analysis mathematical concepts and more advanced mathematics.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1 The basic properties of the field of real numbers.
- CLO2 The series of real numbers and convergence.
- CLO3 Provide the knowledge of Bolzano- Weirstrass theorem and ability to apply the theorem in a correct mathematical way.
- CLO4 Introduce many mathematical concepts studied in Real mathematics such as the real functions
- CLO5 limits, continuity, differentiability of real functions and its related theorems.

Unit-I: Definition and existence of Riemann-Stieltjes integral and its Properties, Integration and differentiation, The fundamental theorem of Calculus.

Unit-II: Integration of vector-valued functions, Rectifiable curves. Rearrangements of terms of a series. Riemann's theorem.

Unit-III: Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's

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tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem.

Unit-IV: Power series, uniqueness theorem for power series, Abel's and Tauber's theorems. Functions of several variables, linear transformations.

Unit-V: Derivatives in an open subset of R^n , Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem.

Text Book: Walter Rudin, Principles of Mathematical Analysis, McGraw Hill, 1978.

Reference Books: 1. T.M. Apostol, Mathematical Analysis, Narosa.
2. H.L. Royden, Real Analysis, Macmillan (Indian Edition)

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
FIRST SEMESTER
CORE PAPER III: TOPOLOGY-I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To classify sets with various properties like finiteness, infiniteness, countability, uncountability, etc. To present an introduction to the essentials of general topology with an emphasis on those aspects which are basic to higher mathematics. To stress on ideas of abstraction and aesthetics, development of mathematical tools and use of mathematical language.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1. Develop their abstract thinking skills.
- CLO2. Understand the concept of cardinality.
- CLO3. Gain knowledge of basic concepts of topology.
- CLO4. Gain in mathematical maturity.
- CLO5. Gain competency in writing proofs.

Unit -I: Equivalent Sets, Denumerable, Countable, infinite and uncountable sets. The Continuum, Schoreder-Bernstein theorem, Concept of cardinality, equivalence of $(0,1)$, $(0, 1]$, $[0, 1)$, $[0, 1]$,

Cantor's theorem and Continuum Hypothesis, Partially ordered sets, First and the last elements, Maximal & Minimal elements, upper and lower bounds, Zorn's Lemma, Axiom of Choice and Well-ordering principle . (As given in chapter -1, Article No. 1.7, 1.9, 1.10 of J. R. Munkre's book, chapter 3 of Seymour Lipschitz's book)

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Unit – II: The definition and some examples of topological space, Topological Subspaces, limit point, derived set, Elementary concepts of open sets, closed sets, closure of a set, dense set, everywhere dense and nowhere dense set. Neighborhood of a point on a set in a topological spaces, isolated point of a set, Interior and boundary of a set. (Chapter 5- S.L. Book)

Unit – III: Continuous maps and homeomorphism of topological spaces, an open base and open sub-base for topological space (As given in the Chapter-II of G.F. Simmons Book, chapter 6-7, of Seymour Lipschitz's book)

Unit – IV: First and Second Countable spaces, Lindelof's theorems, Separable spaces (As given in the Chapter-III of G.F. Simmons Book, chapter 9 of Seymour Lipschitz's book)

Unit – V: Disconnected and Connected sets and spaces, Connectedness on Real line, Components, totally disconnected spaces, Locally connected spaces, Topologist's sine curve (As given in the Chapter-VI of G.F. Simmons Book, chapter 13 of Seymour Lipschitz's book)

Text Book:

1. Seymour Lipschitz, Theory and Problem of general Topology, Schaum Publishing co. N.Y., 1965.
2. G. F. Simmons, Topology and Modern Analysis , McGraw Hill International Edition, 1963.
3. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd. New Delhi., 1988.

Reference Books:

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, New Delhi, 1983.
2. I. Kelly, General Topology, Van Nostrand, New York, 1995.
3. K. Chandra Shekhara Rao, Topology, Narosa Publications, 2009.
4. J. P. Chauhan and J. N. Sharma, Topology, Krishana Publications, 2015.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
FIRST SEMESTER

CORE PAPER IV: COMPLEX ANALYSIS -I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Understand complex numbers provide a satisfying extension of the real numbers, a function of complex variable and carry out basic mathematical operations with complex numbers.

COURSE LEARNING OUTCOMES:

On completion of syllabus student will be able to

- CLO 1** – Understand the significance of differentiability for complex functions and be familiar with the Cauchy –Riemann equations.
- CLO 2**- Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's theorem.
- CLO 3**- Compute the Taylor and Laurent expansions of simple functions, determining the nature of singularities and calculating residues.
- CLO 4**- Use the Cauchy Residue theorem to evaluate integrals and sum series.
- CLO 5** - Understand about Bilinear transformations, cross ratio and fixed points.

UNIT I : Complex integration, Rectifiable arcs, Contours, Complex line integrals, Evaluation of some integrals by direct definition, Complex integral as sum of two real line integrals, The absolute value of a complex integral, The Elementary form of Cauchy's Theorem, Extension of the Cauchy's Theorem,

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UNIT II : Cauchy integral formula, Cauchy's Integral formula for the derivative of an analytic function, Cauchy's Integral formula for Higher order Derivatives. Morera's theorem, Cauchy's inequality theorem, Liouville's theorem, Taylor's theorem.

UNIT III : Laurent Theorem, Singularities, Poles and zeros of a Meromorphic function, The argument principle, Rouché's theorem, The fundamental Theorem of algebra, The maximum modulus principle, Schwartz lemma.

UNIT IV : Residues, Cauchy's residue theorem, Evaluation of certain integrals, Integrals of

type $\int_0^{2\pi} R(\cos \theta, \sin \theta) d\theta$, Integrals of type $\int_{-\infty}^{\infty} f(x) dx$,

Integrals of type $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \sin mx dx$, $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \cos mx dx$, Case of poles on the real axis.

UNIT V : Bilinear transformations, Elementary Transformations, Product of two Bilinear transformations, The linear group, Cross Ratio, Preservation of Cross Ratio under Bilinear transformations, Two important families of circles, Fixed point of a Bilinear transformations, Normal form of a Bilinear transformation.

Text Book:

1. J.B. Conway, Function of one complex variable, Springer-Verlag, 1980.

Reference Books:

1. S. Ponnuswamy, Foundation of complex analysis, Narosa Publishing House, 1997.
2. L.V. Ahlfors, complex analysis, McGraw Hill, 1979.
3. M.L. Khanna, Complex Analysis
4. H.K. Pathak, Complex Analysis

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
FIRST SEMESTER

CORE ELECTIVE PAPER V(A) :FUNCTIONAL ANALYSIS - I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To get familiar with concepts of a normed linear spaces. To achieve knowledge and understanding of Banach spaces and their various properties. To give a working knowledge of the basic properties of Quotient spaces, bounded linear operators and functionals. To show the use of abstract algebraic/topological structures in studying spaces of functions.

COURSE LEARNING OUTCOME:

Upon successful completion of this course, the student will be able to:

- CLO1. Appreciate how functional analysis uses and unifies ideas from vector spaces, the theory of metrics, and complex analysis.
- CLO2. Work comfortably with Banach spaces.
- CLO3. Understand normed linear spaces and their compatibilities.
- CLO4. Enhance the knowledge regarding Quotient spaces.
- CLO5. Understand basic theorems including Hahn Banach Theorem.
- CLO6. Acquire knowledge of bounded operators and functionals.

Unit-I: Normed linear spaces, Banach spaces and examples, Properties of Normed linear spaces, Basic properties of finite dimensional normed linear spaces.

Unit-II: Finite dimensional Normed linear spaces & Sub spaces, Equivalent norms, Riesz Lemma and Compactness.

Unit-III: Definition and properties of cosets in normed linear spaces. Quotient space of normed linear spaces and its completeness.

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Unit-IV: Bounded linear operators & continuous operators, Normed Linear spaces operators.

Unit-V: Linear functional, bounded linear functional, Dual spaces with examples. Hahn-Banach theorem.

Text Book:

1. G. F. Simmons, Topology and Modern Analysis , McGraw Hill International Edition, 1963.
2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.

Reference Books:

1. R. E. Edward, Functional Analysis, Dover Publication, New York, 1995.
2. P. K. Jain, O. P. Ahuja and Khalil Ahmed, Functional Analysis, New Age International (P) Ltd. Publ, 2004.

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ST. ALOYSIUS COLLEGE (AUTO.), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. SC. (MATHEMATICS) FIRST SEMESTER

CORE ELECTIVE PAPER V(B): INTEGRAL TRANSFORM

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course is aimed at exposing the students to Laplace and Fourier Transforms of different functions and their applications in solving Differential equations, Partial Differential equations, Initial Value and Boundary Value Problems.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO 1 Calculate the Laplace Transform and Inverse Laplace Transform of standard functions.

CLO 2 Select and use the appropriate shift theorems in finding Laplace and Inverse Laplace transforms of elementary functions.

CLO 3 Will be able to find the solution of Heat Conduction Equation, Boundary Value Problems and electric circuits. Also they will be able to apply the Laplace Transform to beam and dynamics.

CLO 4 Calculate the Fourier transform, Complex Fourier Transform, Fourier Sine transform and Fourier cosine transform of elementary functions.

CLO 5 Calculate the Fourier Transform of the derivatives.

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Unit - I:

Laplace Transform, Properties of Laplace Transform, Laplace Transform of Derivatives of function, Inverse Laplace Transform, Properties of Inverse Laplace Transform, Inverse Laplace Transform of Derivatives, Convolution theorem.

Unit - II:

Application of Laplace Transforms to solution of differential equations, solution of initial value problem, Laplace's equations, Laplace wave equation. Application of Laplace Transforms in Heat Conduction equation.

Unit - III:

Application of Laplace Transforms to Boundary Value Problems, Electric Circuits, and Application to Beams.

Unit - IV:

The Fourier Transform, The complex Fourier Transform, Inversion Formula, Fourier Cosine and Sine transform properties of Fourier transforms, Convolution & Parseval's identity.

Unit - V:

Fourier Transform of the derivatives, Finite Fourier sine & Cosine Transform, Inversion Operational and combined Fourier transform.

Books recommended:

Text Book:

1. J.K. Goyal & K. P. Gupta, Integral Transform, PragatiPrakashan, Meerut.
2. A. R. Vashishtha & R. K. Gupta, Integral Transform, Krishna Prakashan Media(P), Limited.

Reference Book:

1. I. N. Sneddon, Integral Transform, Tata McGraw-Hill, New York.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
SECOND SEMESTER
CORE PAPER I: ADVANCED ABSTRACT ALGEBRA-II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Give the students experience, knowledge, and confidence to move forward in the study of mathematics.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1 Impart knowledge of some fundamental results and techniques from the Galois theory.
- CLO2 Analyze and demonstrate examples of modules and rings,
- CLO3 Discuss general properties of Modules, Sub modules and Quotient module.
- CLO4 Confer knowledge of Noetherian, Artinian modules and rings.
- CLO5 Appreciate the concepts of finitely generated module over principal ideal domain and its application to finitely generated Abelian groups.

Unit-I: The element of Galois theory: Automorphism of a Field, Group of Automorphisms of a Field, Fixed field and its theorems, Normal Extension and its theorems, Fundamental theorem of Galois theory.

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Unit-II: Introduction of Modules, Examples, General properties of Modules, Submodules and Direct Sum of Submodules, R-homomorphisms and Quotient Modules.

Unit-III: Finitely generated modules, Cyclic modules, Simple modules, Semi-simple modules, Schur's lemma, Free Modules, Rank of a Module.

Unit-IV: Noetherian and Artinian Modules: Examples and theorems, Ascending and Descending Chain Condition (acc and dcc), Noetherian and Artinian Rings, Examples, Hilbert Basis theorem.

Unit-V: Finitely Generated Modules over a Principal Ideal Domain, Fundamental Structure theorem of Finitely Generated Modules over a Principal Ideal Domain, Applications to Finitely Generated Abelian Groups.

Text Books :

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975 (For Units II, III, IV, V).
2. A.R. Vasishtha, Modern Algebra, Krishna Prakashan Mandir, Meerut (U.P.) (For Unit I).
3. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Ed.), Cambridge University Press, Indian Edition, 1997 (For Units II, III, IV, V).

Reference Books:

1. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
2. I.S. Luther and I.B.S. Passi, Algebra, Vol. I, Groups, Narosa Publishing House, 1996.
3. Surjeet Singh and Quazi Zameeruddin, Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990.
4. N. Jacobson, Basic Algebra, Vol. I & II, Hindustan Publishing Company, 1980.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
SECOND SEMESTER
CORE PAPER II : REAL ANALYSIS – II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To make the students see and understand the connection and transition between previously studied length of sets concepts and more advanced length concept viz. Measure.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1** The basic tools, concepts and results of measure theory and appreciate its importance in the wider context of mathematics.
- CLO2** The knowledge of null sets, outer measure, measurable sets and Lebesgue measure, sigma-fields.
- CLO3** Introduce many mathematical concepts studied in mathematics such as the Lebesgue integration, Fatou's Lemma, Monotone and Dominated Convergence Theorems.
- CLO4** Understand the concept of Convex function and its geometrical representation
- CLO5** Understand the concept of Dual space and convergence in measure

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Unit-I: Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets.

Unit-II: Integration of Non-negative functions. The General integral. Integration of Series, Riemann and Lebesgue Integrals.

Unit-III: The Four derivatives. Functions of Bounded variation. Lebesgue Differentiation Theorem, Differentiation and Integration.

Unit-IV: The LP-spaces, Convex functions, Jensen's inequality. Holder and Minkowski inequalities. Completeness of LP.

Unit-V: Dual of space when $1 \leq P < \infty$, Convergence in Measure, Uniform Convergence and almost Uniform Convergence.

Text Book: G. de Barra. Measure Theory and Integration, Wiley Eastern (Indian Ed.).

Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill, International student edition.
2. H.L. Royden, Real Analysis, Macmillan, Indian Edition.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
SECOND SEMESTER
CORE PAPER III: ORDINARY AND PARTIAL DIFFERENTIAL
EQUATION

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To make the students see and understand the ordinary and partial differential equation and also different methods to solve differential equation at ordinary and singular points.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1.** Classify ordinary and partial differential equation.
- CLO2.** Use power series method to solve differential equations about ordinary points.
- CLO3.** Use the Method of Frobenius to solve differential equations about regular singular points.
- CLO4.** Evaluate Laplace transform of a function its inverse. Find the Laplace transform of derivatives, integrals and periodic functions.
- CLO5.** Apply Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.

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UNIT I Exact differential equations and adjoints, The adjoint operator, Lagrange's identity, Sturm-Liouville differential equation, Eigen values, The normal form, change of independent's variable, Lagrange's method of variation of parameters.

UNIT II Partial differential equation, Construction of partial differential equation of first order, Lagrange's linear equation, Charpit's general method of solutions, Green's functions, Domain and range of the operators, One dimensional Green's functions, Construction of Green's functions.

UNIT III Power series solution and special functions, A review of power series, Series solution of first order linear equations, Second order linear equations, Ordinary points, Regular singular points, Gauss's hypergeometric series.

UNIT-IV Laplace Transforms, Integral transforms, A few remarks on the theory, Conditions for the existence of Laplace transforms, Applications to differential equations.

UNIT-V Derivatives and integrals of Laplace transforms, Convolutions and Abel's Mechanical problem. More about convolutions, The unit step and impulse functions.

Text Books:

1. G.F.Simmons, Differential Equation with applications and Historical Notes, McGraw Hill international Editions, 1991(for Units IV&V)
2. B.P Parashar; Differential and Integral Equations, CBS publishers and Distributors Ltd. 1992(for Units I,II&III).

Reference Books:

1. H.T.H. Piaggio, An Elementary Treatise on differential Equations and Their Applications, Indian Reprint, 1966.
2. E.A. Coddington, An Introduction, The Solution of Ordinary Differential Equations, Indian reprint.
3. B.L.Ince and I.N.Sneddon, The Solution of Ordinary Differential Equations, Longman, 1987.
4. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill International Editions, 1957

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
SECOND SEMESTER
CORE PAPER IV : COMPLEX ANALYSIS II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Learn techniques of analysis that make practical problems easy (e.g. graphical rotation and scaling as an example of complex multiplication) , Appreciate how mathematics is used in design(e.g. conformal mapping).

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO 1 Perform basic algebraic manipulation with complex numbers
- CLO 2 Understand the geometric interpretation of complex numbers
- CLO 3 Know methods of finding the n th roots of complex numbers and the solutions of simple polynomial equations.
- CLO 4 Use analytical functions and conformal mappings;
- CLO 5 Compute definite integrals using residue calculus;

UNIT 1. Weierstrass factorization theorem, Gamma function, Euler's Gamma function, Properties of Gamma function, Gauss' Formula, Functional Equation, The Riemann Zeta function, Extension of Zeta Function, Riemann's functional Equation.

UNIT 2. Mittag-Leffler's theorem, Analytic Continuation, Uniqueness of Analytic Continuation, Power series Method of Analytic Continuation, Schwarz's Reflection Principal for Symmetric Region.

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UNIT 3. Harmonic functions, Basic Properties of Harmonic Functions, Harmonic Conjugates, Mean-Valued Theorem for Harmonic Functions, Harmonic Functions on a Disc, Poisson Kernel, Proposition, Harnack's inequality.

UNIT 4. Calculus of Residues, Evaluation of Certain integrals, Integral of type Case of poles on the Real Axis(Indenting Method), Integrals of Many Valued Function such as Z^a , $\log Z$, A Quadrant or a sector of a circle as the contour.

UNIT 5. Conformal mappings, Sufficient condition for $w=f(z)$ to represent a Conformal Mapping, Necessary condition for $w=f(z)$ to represent a Conformal Mapping, Certain type of transformations, Translation $w=z+\alpha$, rotation only, Magnification only, Magnification and rotation both, Translation, Magnification and Rotation, Rotation and Inversion.

Text Book :

J.B. Convey, Function of one complex variable, Springer-Verlag, 1980.

Reference Books:

1. S. Ponnuswamy, Foundation of complex analysis, Narosa Publishing House, 1997.
2. L.V. Ahlfors, complex analysis, McGraw Hill, 1979.
3. E. C. Titchmarsh, The theory of functions, Oxford University, Press, London.
4. Dr. H.K. Pathak, Complex Analysis

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
SECOND SEMESTER
CORE ELECTIVE PAPER V(A) : NUMBER THEORY

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To expose students Number Theory as a beautiful subject of Mathematics because of its treasure of fascinating problems and academic appeal. To understand the idea behind the famous quotation of Gauss on number theory. To allow students to experience mathematics as imaginative, empirical science.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1.** Understand effective expression of concepts and results in number theory.
- CLO2.** Construct mathematical proofs of statements and explore counter examples to false statements.
- CLO3.** Understand the logic and techniques behind the major proofs in number theory.
- CLO4.** Gain perception of numerous applications in mathematics as well as in practical applications like cryptography of results from number theory.
- CLO5.** Attempt many unsolved problems in number theory.

Unit-I: Divisibility theory in integers: Division algorithm, Greatest common divisor, Euclidean algorithm.

Primes and their distribution: The fundamental theorem of arithmetic, the sieve of Eratosthenes, the Goldbach conjecture.

Unit-II: The theory of congruence: Basic properties of congruences, binary and decimal representations of integers.

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Fermat's Little theorem and pseudoprimes, Wilson's theorem, the Fermat-Kraitchik factorisation method, Chinese Remainder Theorem.

Unit-III: Number-Theoretic Functions: $\phi(n)$, $d(n)$, $\sigma(n)$, $\mu(n)$ and their properties, Mobius inversion formula, the greatest integer function, Euler's theorem.

Unit-IV: Primitive roots: The order of an integer modulo n , Lagrange's theorem, composite numbers having primitive roots, the theory of indices.

Euler's criterion, Legendre's symbol and its properties, Quadratic reciprocity Law.

Unit-V: Introduction to Cryptography: From Caesar cipher to public key cryptography, the Knapsack cryptosystem, an application of primitive roots to cryptography.

Numbers of special form: Mersenne primes and perfect numbers.

Certain Diophantine equations: $ax + by = c$, $x^2 + y^2 = z^2$, Fermat's Last Theorem (without proof)

Text book –

1. Burton, D.M., *Elementary Number Theory, 7th Edition*, MacGraw-Hill Education, 2010 .

Reference Books:

1. Niven I., Zuckerman, H.S. and Montgomery, H.L., *Introduction to Theory of Numbers, 5th Edition*, John Wiley & Sons, 1991.
2. Hardy, G.H., and Wright, E.M., *Introduction to Theory of Numbers, 4th Edition*, Oxford University Press, 1991.
3. Silverman, J.H., *A Friendly Introduction to Number Theory, 3rd Edition*, Pearson, 2009.
4. Robbins, N., *Beginning Number Theory, 2nd Edition*, Jones and Bartlett Publishers, 2006.
5. Chowdhury, K.C., *A First Course in Theory of Numbers*, Asian Books Pvt. Ltd., 2007.
6. Stewart, B. M., *Theory of Numbers*, The Mac-millan company, 1964.
7. Koshy T. *Elementary Number Theory*, Academic Press , 2007.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2021-22
M. Sc. (MATHEMATICS)
SECOND SEMESTER
CORE ELECTIVE PAPER V(B): TOPOLOGY-II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

Course Objective:

To train the students in the area of topology. To give adequate knowledge of the subject that can be used by the students for further applications in their respective sphere of interest.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO 1 Acquisition of knowledge in various topics of topology.
- CLO 2 Appreciation of beauty of profound mathematical results such as Heine-Borel theorem and Urysohn's Lemma.
- CLO 3 Understanding the dynamics of methods of mathematical proof.
- CLO 4 Understanding the Nets, Filters, Convergence, Ultra Filters and Compactness.
- CLO 5 Understanding the fundamental group, covering spaces and Homotopy of Paths.

Unit -I: Continuous functions and compact sets, Basic properties of Compactness, Compactness and Finite Intersection Property, Product of spaces, Projection maps, Tychonoff's theorem, Local compactness, Heine Borel theorem.

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Unit – II: Separation: T_1 -spaces, Hausdorff spaces, Regular, Completely regular spaces and Normal spaces, their characterization and basic properties (As given in the Chapter-V of G.F. Simmons Book)

Unit – III: Urysohn's Lemma, Tietze extension theorem, one-point compactification, the Stone-Čech compactification, Urysohn Metrization theorem (As given in the Chapter-V of G.F. Simmons Book)

Unit – IV: Net's & Filters, Topology and convergence of Nets, Hausdorffness & Nets, Compactness & Nets, Filters and Convergence, Ultra Filters and Compactness.

Unit – V: The fundamental group and covering spaces, Homotopy of Paths, The Fundamental Group, Homomorphism, Covering spaces, The Fundamental Group of the circle.

Text Book:

1. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd. New Delhi.
2. G. F. Simmons, Topology and Modern Analysis, McGraw Hill International Edition, 1963.

Reference Books:

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, New Delhi.
2. J. L. Kelly, General Topology, Van Nostrand, New York, 1995.
3. K. Chandra Shekhara Rao, Topology, Narosa Publications.
4. J. P. Chauhan and J. N. Sharma, Krishana Publications.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE PAPER I: OPERATIONS RESEARCH -I

CREDIT: 5
Max. Marks 40
Min. Marks 14

COURSE OBJECTIVE:

The course aspires to make students understand, apply design and evaluate different types of Linear Programming Problems in Operations Research.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1:** Comprehend the origin, development, characteristics, phases and applications of Operations Research.
- CLO2:** Design a LPP in real world objective and evaluate an optimal solution for the linear programming problem by graphical and simplex method
- CLO3:** Correlate LPP to its corresponding dual LPP and evaluate by simplex, two-phase and Big-M method.
- CLO4:** Frame and solve transportation problems.
- CLO5:** Analyze and evaluate replacement problems.

Unit-I: Operations Research and its scope. Origin and Development of Operations Research, Characteristics of Operations Research, Phase of Operations Research, Uses of Operations Research, Role of Operations Research in Decision Making.

Unit-II: Linear Programming Problem, Mathematical Formulation of the Linear Programming Problem, Solution of LPP by Graphical method, Solution of LPP by Simplex method.

Unit-III: Solution of a Linear Programming Problem by Big-M method, Solution of LPP by Two phase method, concept of duality, Advantages of duality, Dual simplex method, Primal of dual Correspondence.

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Unit-IV: Transportation problem, Initial basic feasible solution by North-West Corner Rule, Row Minima Method, Column Minima Method, Matrix Minima Method and Vogel's Approximation method, Optimality test by MODI method, Degeneracy in Transportation Problem, Unbalanced Transportation problem .
Unit-V: Replacement problem: Replacement Policy Theorem, Concepts: Money Value, Present worth factor discount, Replacement problem when money value is constant / money value changes with Time, Individual replacement, and Group replacement.

Text Books:

1. S.D. Sharma; Operations Research.

Reference Books:

1. K. Swarup, P. K. Gupta and Manmohan; Operations Research, Sultan Chand & Sons, New Delhi.
2. H. Hadley; Linear and Dynamic programming, Addison-Wesley Reading Mass.
3. F.S. Hiller and G.J. Lieberman; Industrial Engineering Series, 1995.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE PAPER II : SPECIAL FUNCTIONS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To make the students see and understand the gamma, beta function and also hypergeometric, Bessel, Legendre and Hermite differential equations.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO 1 Explain the applications and the usefulness of the special functions.
- CLO 2 Understand purpose and functions of the gamma and beta functions
- CLO 3 Use power series methods to solve differential equations.
- CLO 4 Perform operations Bessel differential equations along with the corresponding recurrence formulas of different functions.
- CLO 5 Perform operations Legendre differential equations along with the corresponding recurrence formulas, orthogonal property of different functions.

Unit I Gamma and Beta Functions : The Euler or Mascheroni Constant γ , Gamma Function, A series for $\Gamma'(z) / \Gamma(z)$, Difference equation $\Gamma(z+1) = z\Gamma(z)$, Euler's integral for $\Gamma(z)$, Beta function, value of $\Gamma(z)\Gamma(1-z)$, Factorial Function, Legendre's duplication formula, Gauss multiplication theorem, Relations between functions of z and $1-z$.

Unit - II Hypergeometric and Generalized Hypergeometric functions: Function ${}_2F_1(a,b;c;z)$ A simple integral form evaluation of ${}_2F_1(a,b;c;z)$ Contiguous

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function relations, Hyper geometrical differential equation and its solutions, $F(a,b;c;z)$ as function of its parameters, Elementary series manipulations, Simple transformation,

Unit-III Bessel function, Definition of $J_n(z)$, Bessel's differential equation, Generating function for $J_n(z)$, Recurrence Relations for $J_n(z)$, Bessel's integral with index half and an odd integer, Orthogonality of Bessel Functions.

Unit-IV Generating function for Legendre polynomials, Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of $P_n(x)$, Special properties of $P_n(x)$, Some more generating functions, Laplace's first integral form, Orthogonality.

Unit-V Hermite polynomial: Definition of Hermite polynomials $H_n(x)$, Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Orthogonality, Expansion of polynomials, more generating functions..

Books Recommended ;

- 1- Rainville, E.D.; Special Functions, The Macmillan co., New York 1971,
- 2- Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
- 3- Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.

Reference Books.

- 1- Lebedev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New Jersey, USA 1995.
- 2- Whittaker, E.T. and Watson, G.N., A Course of Modern Analysis Cambridge University Press, London, 1963.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE PAPER III : NUMERICAL METHODS I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Understand the numerical methods and their analysis for solving different types of linear and non-linear systems..

COURSE LEARNING OUTCOMES:

Upon completion of the course, Students will be able to

- CLO 1** Solve Hermite Piecewise Interpolation, Piecewise Linear interpolation, Quadratic interpolation, Cubic Interpolation, Piecewise Cubic Interpolation using Hermite Type Data.
- CLO 2** Understand Cubic Spline Interpolation, Bivariate Interpolation and Lagrange Bivariate Interpolation.
- CLO 3** Understand Euclidean Norm and Uniform for Discrete Data and Continuous Data,
- CLO 4** Find Least Square approximation, Legendre Polynomial and Chebeshev Polynomials Approximation.
- CLO 5** Understand Numerical Differentiation, Method Based on Interpolation and Method Based on Finite Differences.

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Unit - I

Hermite Interpolation Piecewise Interpolation, Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise Cubic Interpolation, Piecewise Cubic Interpolation using Hermite Type Data, spline interpolation, Quadratic spline interpolation, Cubic spline interpolation, Natural Spline.

UNIT - II :

Bivariate interpolation, Lagrange Bivariate interpolation, Newton's Bivariate interpolation for Equispaced Points.

UNIT III :

Approximation, L^p Norm, Euclidean Norm and Uniform Norm for Discrete Data and Continuous Data, Least squares Approximation, Gram-Schmidt Orthogonalizing Process, Legendre Polynomials, Chebyshev Polynomials.

UNIT IV : Uniform Approximation, Uniform (minimax) Polynomial Approximation (Chebyshev Approximation), Chebyshev Polynomials Approximation and Lanczos Economization, Rational Approximation, Choice of the method.

UNIT V : Numerical differentiation, Method Based on Interpolation, Non-uniform Nodal Points (Linear Interpolation, Quadratic Interpolation), Uniform Nodal Points (Linear Interpolation, Quadratic Interpolation), Method Based on Finite Differences, Method Based on Undetermined Coefficients, Optimum choice of step length.

Text Book :

Numerical Method for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger, R.K. Jain south Edition (2003), New Age.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER

CORE ELECTIVE PAPER IV(A): PROGRAMMING IN C

CREDIT: 5
MAX MARKS: 25
MIN MARKS: 09

COURSE OBJECTIVE:

The **course** is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO1 Provide exposure to problem-solving through programming.
- CLO2 Understand the fundamentals of C programming.
- CLO3 Train the student to the basic concepts viz. conditional and decision making, file handling of the C-programming language.
- CLO4 Understand the array and multi-dimensional arrays
- CLO5 Find Common Programming Error, Program testing and debugging.

Unit-1: An overview of programming languages , Programmes development, functions Variables and Constants Expressions. Formatting sources files continuation character, the Processors.

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Unit-2: Scaler data type-Declarations, different types of integers. Different kinds of Integer Constants Floating-point type Initialization, Mixing types, Explicit conversions-casts. Enumeration types. The void data type ,Type defs.

Unit-3: Control flow-Conditional Branching, the switch statement. Looping. Nested Loops, the Break and Continue Statement. The Goto Statement Infinite Loops. Operators and Expressions-Precidence and Associativity. Unary plus and Minus operator. Binary, Arithmetic operator, arithmetic assignment operators. Increment and Decrement operator. Comma Operator, Relational Operators, Logical Operators bit-manipulation operators Bitwise assignment operators, size of operators, Conditional operators.

Unit-4: Array and multi dimensional arrays. Storage Classes-fixed vs. Automatic duration scope, global. The Register Specifier Structures and Unions, Pointers.

Unit-5: Developing a C Program: Introduction, Common Programming Error, Program testing and debugging, Program Efficiency. File management in C:Introduction, defining a file, closing a file, input/output operation On files, error handling during I/O operation.

Reference Books:

1. Samuel P.Harkison and Gly L Steels Jr.C:A reference manuel, II Edition ball 1984
2. Brain W Keringham & Dennis M Richie the C Programmed Language II edition(ANSI features) Prentice Hall 1989.

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DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER

OPEN ELECTIVE PAPER V(A) ADVANCED DISCRETE
MATHEMATICS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course aspires to make students understand, analyze and evaluate algebraic structures, lattices. Boolean algebra, graphs and trees

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO 1 Understand and analyze the basic principles and results of algebraic structures, semi groups, monoids and their properties.
- CLO 2 Understand and reframe concept of different kinds of lattices
- CLO 3 Understand and implement concepts of Boolean Algebra
- CLO 4 Comprehend and apply different types of graphs and circuit in real life problems
- CLO 5 Demonstrate different traversal methods for trees and graphs

Unit-I: Algebraic systems, semigroup, monoid, subsemigroup and submonoid definition and examples, direct product of semigroup, homomorphism and isomorphism of semi group, homomorphism and isomorphism of monoid.

Unit-II: Partial order relation, total order relation, partially ordered set- poset, chain, antichain, definition and examples, Hasse diagram, dual of a poset, homomorphism and isomorphism of a poset. Lattices as posets, lattices as algebraic systems, complete lattice, complemented lattice, bounded lattice, distributive lattice, dual of a lattice, sub lattices, definition, examples and general properties of a lattices, direct product of lattices, homomorphism and isomorphism of lattices.

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Unit-III: Boolean lattice, Boolean algebra, definition, examples and general properties, principle of duality, sub Boolean algebra, direct product of Boolean algebra, homomorphism and isomorphism of Boolean algebra.

Unit-IV: Edges, incidence and adjacency of edges, vertex, degree of a vertex, even, odd, isolated and pendant vertex, simple graph, multi graph, regular graph, null graph, finite graph, infinite graph, digraph, planar graph, non planar graph, complete graph, bipartite graph, definition and general properties, hand shaking lemma, isomorphic graphs, homeomorphic graphs, subgraph, vertex disjoint subgraph, edge disjoint subgraph, walk, path and circuit, labeled graph, weighted graph, shortest path in weighted graph, Dijkstra's algorithm, matrix representation of graphs and digraphs.

Unit-V: Connected graph, disconnected graph, components, minimally connected graph, definition and general properties. Tree, pendant vertex in a tree, internal vertex in a tree, distance and centers in a tree, radius of a tree, diameter of a tree, path length of a tree, rooted tree, binary tree, strictly binary tree, levels and height of a binary tree, definition and examples. Applications: Konigsberg bridge problem, utilities problem, Chinese postman problem and determining the longest monotonically increasing subsequence,

Text Books:

1. H. K. Pathak and J. P. Chauhan; Advanced Discrete Mathematics, Shiksha Sahitya Prakashan.
2. J. P. Tremblay & R. Manohar; Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

Reference Books:

1. C. L. Liu; Elements of Discrete Mathematics, McGraw-Hill Book Co.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
OPEN ELECTIVE PAPER V(B) MATHEMATICAL STATISTICS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Recognize the importance and value of mathematical and statistical thinking, training, and approach to problem solving, on a diverse variety of discipline and be familiar with a variety of examples where mathematics or statistics helps accurately explain abstract or physical phenomena.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1 Properties of statistical models,

CLO2 Knowledge of Probability theory including conditional probability.

Distribution such as Binomial, Poisson etc.

CLO3 Understand and apply the concepts of t and F Distributions and other distribution functions.

CLO4 Construct tests and estimators, and derive their properties

CLO5 Know about important theorems like Rao –Blackwell theorem-The Rao Cramer's inequality

UNIT –I: The probability set function –Random variables –The probability density function – The distribution function-Mathematical expectations-Some special mathematical expectations – Chebyshev inequality.

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UNIT – II Conditional probability –Marginal and conditional distributions-The Correlation coefficient-Stochastic Independence. The Binomial, Poisson, Gamma, chi-square normal distribution.

UNIT – III: Distributions of functions of Random variables –Sampling theory-Transformation of Variables of Discrete type-Transformation of Variables of the continues type.

UNIT – IV: The t and F Distributions – Distribution of order statistics –The moment –generating function Technique-The Distribution of X and.Limiting distribution –Stochastic convergence-Limiting moment generating function-The central limit theorem –Some theorems on Limiting Distribution.

UNIT-V: Point estimation-Measures of quality of estimations-confidence intervals for meansconfidence intervals for difference of Means-confidence intervals for variances. A Sufficient statistics for a parameters- The Rao –Blackwell theorem-The Rao Cramer's inequality.

Text Book: Introduction to Mathematical Statistics by Robert V. Hogg Allen T. Craig, Macmillan publishing co., Inc., New York -1978,

References : 1. Mathematical Statistics by J.N. Kapur, H.C. Saxena- S. Chand Publications 2.Introduction to Mathematical Statistics Robert V Hogg, Allencraig, Joseph W Mekean , Pearson Publishers

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
FOURTH SEMESTER
CORE PAPER I: OPERATION RESEARCH-II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course aspires to make students comprehend, formulate, analyze and determine optimal solution to real life problems.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

- CLO 1** Formulate, solve and apply assignment problems so that cost is minimized.
- CLO 2** Frame and evaluate job sequencing problems
- CLO 3** Deduce the practicality of game theory and implement the techniques in real life perspective.
- CLO 4** Develop a working knowledge of concepts and methods related to designing of networks, CPM-PERT, design, manage and complete projects in optimal time.
- CLO 5** Understand the concepts of various inventory models, EOQ, multi items deterministic model and evaluate the cost involved therein. Control resource allocation and manage inventory.

Unit-I: Mathematical formulation of assignment problem, assignment algorithm, solution of assignment problem by Hungarian method, rules to draw minimum number of lines, unbalanced assignment problem, maximal assignment problem, traveling salesman problem.

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Unit-II: Sequencing problem, Johnson's algorithm, idle time, elapsed time, processing n jobs on two machines, n jobs on three machines, n jobs on m machines, processing two jobs through m machines.

Unit-III: Two person zero-sum game, maximin-minimax principle, games with/without saddle points, graphical solution of $(2 \times m)$ and $(m \times 2)$ games, principal of dominance, value of the game, optimal strategies.

Unit-IV: Introduction, historical development and applications of CPM and PERT, concepts, network diagram representation, Fulkerson's rule, backward pass computation, forward pass computation, total float, free float, independent float, network construction, CPM and PERT calculations, Project management by CPM and PERT.

Unit V: Inventory theory, types of inventory models, cost involved in inventory problems, variables in inventory problems, average inventory, concept of EOQ, economic lot size system with uniform and non-uniform demand, economic lot size with finite rate of replacement, production lot size model, multi items deterministic models with one constraint, limitation on investment, floor space and inventory.

TEXT BOOKS:

1. S. D. Sharma; Operations Research.

REFERENCE BOOKS:

1. K. Swarup; P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.
2. H. A. Taha; Operations Research- An introduction, Macmillan Publishing Co. Inc. New York.
3. P. K. Gupta and D. S. Hira; Operations Research, an Introduction, S. Chand & Company Ltd. New Delhi.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
FOURTH SEMESTER
CORE PAPER II : NUMERICAL METHODS II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The students will learn extrapolation methods and the mathematical theory of finite element methods.

COURSE LEARNING OUTCOMES:

Upon completion of the course, Students will be able to

- CLO 1** Understand extrapolation methods, Richardson's extrapolation and ordinary differential equations.
- CLO 2** Knowledge of multi step methods, explicit multistep methods and implicit multistep method.
- CLO 3** Solve boundary value problem with different conditions, linear second order differential equations by different methods.
- CLO 4** Understand Finite difference methods and Linear Second Order Differential Equation.
- CLO 5** Understand finite element methods and linear Lagrange polynomial.

Unit 1 Extrapolation methods, Richardson's Extrapolation, Ordinary differential equations, Reduction of Higher order Equations to the system of first order Differential Equations, system of Linear first order Differential Equations with Constant Coefficients, Difference Equations.

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